JOHNS HOPKINS
U N I V E R S I T Y

Center for Astrophysical Sciences

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Title: A Proposal to Investigate Outstanding Problems in Astronomy

Period Covered: December 1, 2001 to November 30, 2002
P.I.: Holland Ford, Johns Hopkins University

During the period leading up to the spectacular launch of the Space Shuttle Columbia (STS-109) on 1 March 2002 6:22 am EST, the team worked hard on a myriad of tasks to be ready for launch. Our launch support included preparations and rehearsals for the support during the mission, preparation for the SMOV and ERO program, and work to have the science team's data pipeline (APSIS) and data archive (SDA) ready by launch. A core of the team that was at the GSFC during the EVA that installed ACS monitored the turn-on and aliveness tests of ACS. One hour after installation of ACS in the HST George Hartig was showing those of us at Goddard the telemetry which demonstrated that the HRC and WFC CCDs were cooling to their preset temperatures. The TECs had survived launch! After launch, the team had several immediate and demanding tasks. We had to process the ERO observations through our pipeline and understand the limitations of the ground based-based calibrations, and simultaneously prepare the EROs for public release. The ERO images and the SMOV calibrations demonstrated that ACS met or exceeded its specifications for image quality and sensitivity. It is the most sensitive instrument that Hubble has had. The ERO images themselves made the front page of all of the major newspapers in the US. During the months after launch we have worked on the SMOV observations, and are analyzing the data from our science program. Our understanding of the ACS as of late August was summarized in a series of eleven papers that were given at an SPIE meeting, and that will be published in the SPIE journal (cf Conferences). The first of our science papers has been accepted for publication, and two more based on the ERO observations are ready for submission. We will have drafts of several more papers by the end of the year. We and the astronomical community can look forward to a host of new discoveries and deeper insights into the nature of the Universe that will be provided by ACS observations.

Attached at the end of this report is a summary of the observing programs that have been executed to date.

Personnel:

During 2002, six new personnel joined the team. In January, a postdoctoral fellow with expertise the luminosity function of galaxies started, as well as a graduate student with interest in lensed galaxies and a physics undergraduate who is assisting with data analysis. In June, another graduate student joined the team to work on the SMOV effort. In September 2002, one associate research scientist and another postdoctoral fellow joined the team. Their respective specialties are the evolution of galaxies and dusty disks around young stars. At the same time, we lost an associate research scientists who made a life change. We are advertising for several scientists for the coming year in an attempt to keep manpower levels adequate for data analysis.

Programming and Software Development:

Pipeline Programming Milestones:

The AÇS GTO science pipeline is now officially named APSIS (ACS Pipeline Science Investigation Software). It takes a set of ACS images, aligns them, combines images in each filter, makes a detection image, catalogs sources and measures their basic photometric and structural properties, and determines their photometric redshifts. APSIS was released and ready for use on launch, and has processed all ACS GTO and ERO data obtained with the WFC. The pipeline group consists of K. Anderson (programmer), D. Magee (programmer), J. Blakeslee (scientist/programmer), N. Benitez (scientist/programmer), G. Meurer (scientist/manager), R. Bouwens, N. Cross (scientist), C. Gronwall (scientist), F. Menanteau (scientist), and L. Bonilla (student/programmer). In the past year the pipeline group has accomplished the following:

- Specification and delivery of pre-launch ACS data simulations using the BUCS simulator.
- Final pre-launch testing of APSIS with simulated images (February 2002).
- Initial production version of APSIS, v1.0, released.
- 11 releases of APSIS to production since v1.0, addressing 39 separate enhancement requests and bug reports.
- Uniform APSIS processing of all WFC ERO datasets (April 2002).
- Specified and implemented APSIS operating procedure.
- Specified and implemented APSIS products Quality Assurance (QA) procedure.
- Uniform APSIS processing of all WFC datasets ready for ACS science meeting (July 2002).
- Reprocessed all WFC datasets with new calibration data, (September-October 2002).
- Delivery and initial testing of automated data grouping and APSIS trigger module GROUPER.
- Development of APSIS products QA code.
- Trial APSIS processing of HRC data obtained in parallel and using non standard filters.

Archive Programming Milestones:

Science Archive
- Released version 1.0 in July 2002 and 1.6 in November 2002.
- Demonstrated SDA user interface at team meetings in Wyoming and at JHU.
- Marshalled retrieval and ingest of ACS data from STScI archive and from GTO science data pipeline.
- Wrote SDA release notes and user guide.Purchase, configuration, and maintenance of a fully redundant, high availability, high performance ACS Science Data Archive architecture. This includes three web servers, 1 terabyte of redundant storage, and a database server.
- Some of the features added to the ACS Science Data Archive include:
    - an image cutout service for the ACS Science Data Archive web interface.
    - a clickable object map for the ACS Science Data Archive web interface.
    - a data inventory page for the ACS Science Data Archive web interface.

o an image cutout extraction and visualization tool with various image scaling options, FITS and PNG output, color palette support, histogram autoscaling and equalization, three color image combination, WCS alignment.

General Software Development and Management (Wm. J. McCann):

- Commenced support of RedHat Linux Operating System on workstations and laptops
- Implemented an issue tracking system using Bugzilla for use in the Pipeline, Archive and Simulator.
- Designed and implemented an automated data flow from the HST MAST archive into the ACS GTO Archive. This includes programs to request data sets, process data set requests, and format for ingestion into the ACS team archive.
- Created software to automatically retrieve and summarize HST program status information from various, hard to use pages at the STScI.
- Implemented and managed a centralized ACS software development source code repository
- Developed a hardware management database to facilitate hardware inventory and configuration management and budget analysis and planning.
- Developed a software management database to facilitate software inventory and configuration management.
- Created software to parse and summarize RPS2 format files and post the summaries to a web page.
- Upgraded all UNIX systems to the 64-bit Solaris 8 operating environment.
- Upgraded all 32-bit only SparcStation systems to 64-bit capable machines.
- Doubled the number of installed and supported software packages.
- Increased the size of the server email store by a factor of five.

Hardware:
- Researched, purchased, and configured a robust fully redundant workgroup server.
- Convinced Department and University network support teams to add Gigabit Ethernet networking to the department in order to support ACS data volume.
- Setup and installation of the archive and pipeline server.
- Increased processor speed by approximately five times
- Increased data storage area by approximately six times
- Installed and configured 5 servers
- Installed and configured 25 workstations (includes hardware and/or OS upgrades)
- Installed and configured approximately13 laptops

JHU Travel:
- AAS Meeting (January 2002, in Washington, DC)
- ACS Science Team Meeting (February 26, 2002, in Cape Canaveral, FL)
- SPIE (January 21-24, 2002 San Jose, CA)
- SPIE Opto-Canada Regional Meeting (May, 2002, Ottawa, Canada)
- Workshop at Pont. Univ. Catholica (28-29 May 2002, Santiago, Chile)
- AAS Meeting (June 2002, in Albuquerque, AZ)
- Astrophysics of Life (June 2002, Washington, DC)

- ACS Science Retreat Meeting (July 26-August 2, 2002, in Jackson Hole, WY)
- SPIE Meeting (August 22-28, 2002, Waikoloa, HI)
- ADASS Meeting (October 13-16, 2002, Baltimore, MD)
- STScI Calibration Meeting (October 17-18, 2002, Baltimore, MD)
- Science with the GTC (2-6 February 2002, Granada, Spain)
- Spanish Astronomical Mtg (Septmeber 2002, Toledo, Spain)

Accomplishments and on-going work of paid project personnel

SCIENTISTS

David Ardila, Ph.D., Astronomer
(100% FTE, since 9-1-02)

- Analysis of the faint galaxy population on the first ACS images
- Collaboration in the analysis of the coronagraphic observations of circumstellar disks.
- Working on three presentations for the AAS Meeting in Seattle on January 2003

Narciso Benitez, Ph.D., Astronomer
(100% FTE)

- Analysis of the faint galaxy population on the first ACS images
- Supervision of Dan Coe, and co-supervision of Kerry Capelle
- Member of pipeline team
- Paper on faint galaxies on deep ACS observations
- New method and code for strong lensing modelling
- Improvements to BPZ

John Blakeslee, Ph.D., Astronomer
(100% FTE)

- Major accomplishments have included collaborating on the completion of the ACS science data pipeline. In particular, Blakeslee has completed the image alignment, cosmic ray rejection, and image combination (via drizzle) parts of the pipeline, as well as testing and optimization of parameters and some documentation. He has also written some scripts for use in checking and reformatting ACS data. The ACS GTO pipeline will be described in a contribution by Blakeslee et al. to the ADASS conference in October 2002.
- Along with G. Meurer (JHU), D. Lindler (SS) and Colin Cox (STScI), Blakeslee has worked on the ACS optical distortion calibration effort of the ACS science mission orbital verification (SMOV) campaign. Blakeslee's role was to test the models derived by Don Lindler and cross-check the derived astrometry between instruments and against ground-based catalogs. His analysis showed that a rederivation of the HRC distortion model was necessary, and this has recently been accomplished.

- Blakeslee also participated in SMOV grism calibration program and worked to produce sky flat fields for taking out the large-scale gradients seen in ACS WFC images flattened by the ground-based flat fields. These sky flat fields proved useful for testing the photometric flat fields eventually produced by STScI.
- Blakeslee worked on processing ACS early release observations (ERO) and prepared the images for delivery to the STScI public relations office where they were combined into color images.
- He also worked to calibrate the astrometry of the ERO "Tadpole" galaxy field so that slitmasks could be constructed for spectroscopic observations at Keck Observatory. One of the surprising discoveries in some of the first ACS GTO data was the presence of two distant supernovae in the Hubble Deep Field North. Blakeslee collaborated in writing of the International Astronomical Union circulars announcing this discovery and has continued work on the analysis of these and subsequent observations of this field. A paper presenting and describing these observations is in preparation.
- Blakeslee continues to work on the planning and analysis of the ACS GTO cluster program. First results from this program will be presented in a paper currently in preparation.

Nicholas Cross, Ph.D., Astronomer
(100% 12-29-01 to present)

- SMOV work on cosmic ray rates with Zlatan Tsvetanov
- Developing structural parameter code to calculate half light radii, and Sersic parameters for galaxies and to improve the measurement of the total flux.
- Developing pipeline code to calculate the extinction correction for extragalactic objects.
- Principle pipeline operator:
  - written simple scripts to run the pipeline and group data
  - performed Quality Assurance on much of the pipeline products
  - taught other team members how to run the pipeline.
- Worked on description of the ERO observation of the Cone Nebula
- Submitted an abstract to the January 2003 AAS on the "Evolution of Field Galaxies from $0.5<z<1.5$ in ACS Cluster Fields".

David Golimowski, Ph.D., Astronomer
(71% FTE 12-01-01 to 05-31-02; 100% FTE 06-01-02 to present)

- Managed development of the IDT science data archive (SDA).
  - Released version 1.0 in July 2002 and 1.6 in November 2002.
  - Demonstrated SDA user interface at team meetings in Wyoming and at JHU.
  - Marshalled retrieval and ingest of ACS data from STScI archive and from GTO science data pipeline.
  - Wrote SDA release notes and user guide.
  - Attended and conducted planning meetings of science data pipeline and archive.
- Managed tests of preflash remediation of charge-transfer inefficiency in irradiated non-flight ACS CCDs.
  - Supervised two undergraduate research assistants.

- o Reduced and analyzed data from preflash remediation tests.
- Assembled poster describing HRC coronagraph performance for presentation at the 200th meeting of the American Astronomical Society in Albuquerque.
- Assisted STScI with press releases for ACS Early Release Observations.
- Co-authored journal paper on ERO images of the circumstellar disk around HD 141569A.
- Assisted with the definition of the Cycle 12 observing plan for circumstellar disk targets.
- Served as session chair for HST Calibration Workshop in October 2002.

Caryl Gronwall, Ph.D., Astronomer
(100% FTE; 12-1-01 to 8-31-02)

- Member of ACS Pipeline Working Group
- Maintain the science pipeline web page.
- Maintain the science pipeline development web page to provide easy access to pipeline development documents
- Continue to test ACS data simulator written by Bouwens
- Interface with Bouwens on bugs and needed modifications
- Help with testing the ACS science pipeline on simulated data
- Serve as "data guru" to keep track of which GTO data has been taken, and make sure that it is requested from the STScI archive and processed through pipeline in a timely fashion
- Run ACS science pipeline on ACS GTO science dats
- Lead postdoc recruitment effort: read applications, set-up interviews, participate in interviews, and make job offers
- Participate in bi-weekly telecon to coordinate grism software and calibration efforts with team at ST-ECF
- Test grism extraction software
- Participate in preparing press release material for pre-launch and ERO press conferences
- Radio show interview discussing the ERO images
- Help reduce and analyze first ACS grism data
- Present poster on the first ACS grism data at the AAS Meeting in Albuquerque, NM June 2002

Andre Martel, Ph.D., Astronomer
(92% FTE, 12-1-01 to 11-30-02)

- Assisted in the post-ship verification and functional tests of ACS at the Kennedy Space Center.
- Completed the web pages of the JHU ground calibration activities for ACS (plans, data analysis, reports, CEI spec verification, etc.).
- Attended SPIE conference in Ottawa, Canada: "Pre-Launch Calibration of the Advanced Camera for Surveys", Martel, A.R., & Hartig, G.F., SPIE Opto-Canada Regional Meeting Vol. TD01 (Ottawa), May 2002, 57
- PI on Cycle 11 program GO-9495 "Do the Most Powerful Radio Galaxies Host the Most Massive Black Holes?" (Martel et al., in progress)

- Co-I on Cycle 11 program GO-9142 "The Structure and Physics of Extragalactic Jets" (Perlman et al., in progress)
- Co-I on VLA program AP439 "Structure and Physics of Extragalactic Jets" (Perlman et al., in progress)
- Analysis of the ERO observations of 3C 273: "Coronagraphic Observations of 3C 273 with the Advanced Camera for Surveys," in preparation

Gerhardt Meurer, Ph.D., Astronomer
(100% FTE)

- Managed ACS simulator (BUCS) development with R. Bouwens, parametrized simulations and oversaw delivery of simulated data for GTO, ERO, and SMOV work.
- Negotiated contract for SMOV geometric distortion determination with D. Lindler of Sigma Sci.
- Managed the SMOV geometric distortion campaign. The primary workers in this campaign are D. Lindler, J. Blakeslee, and myself.
- Coordinated work with personnel at STScI: W. Hack, C. Cox, G. Hartig, and M. Clampin.
- Managed the reduction and analysis of the ERO data; prepared the data for APSIS, including preparing reference files, masking out satellite trails, and reducing with CALACS. Oversaw the APSIS processing and initial analysis of the results.
- Analyzed SBC SMOV data and wrote AAS paper (the basis for SBC paper for SPIE, and HST Calibration workshop), primarily with H. Tran, R. Kimble, and G. Hartig .

Marco Sirianni, Ph.D., Astronomer
(88%, FTE, 12-1-01 to 11-30-02)

- Reduction and analysis of data taken during TV3
    - Creation and delivery of ground reference files for the STScI PIPELINE
    - Developed IRAF package for the creation of on-orbit reference files
    - Developed IDL package for reduction of on-orbit CTE data
    - Participated at the Servicing Mission EVA#4 aliveness and functional tests
- Analyzed data from the following SMOV programs
    - 9006 CCD Temperature set point
    - 9005 ACS CCD functional test
    - 8947 ACS weekly test
    - 8948 ACS CTE test
- Created databases of CCD performance
- Developed Proposal for the Interim calibration period
- Developed ACS Cycle 11 photometric Calibratoin programs for CCD performance monitoring and Photometric calibration and transformation
- Member of the ACS photometric working group
- Reduction of ACS ERO data
- Analysis of ACS sensitivity

- Analysis of phototmetric data for the calculation of color tranformation between ACS and other instruments' photometric systems.
- Papers in preparation:
  - M. Sirianni, H. D. Tran, H. C. Ford, G. Illingworth, M. Clampin, G. Hartig, R. H. Becker, R. L. White, F. Bartko, N. Benitez, J. P. Blakeslee, R. Bouwens, T. Broadhurst, R. Brown, C. Burrows, E. Cheng, N. Cross, P. Feldman, M. Franx, D. Golimowski, C. Gronwall, L. Infante, R. Kimble, J. Krist, M. Lesser, D. Magee, A. R. Martel, J. McCann, G. R. Meurer, G. Miley, M. Postman, P. Rosati, W. Sparks, and Z. Tsvetanov, 2002, Young Star Clusters in UGC 10214 and in NGC, ApJ, in preparation
  - The photometric calibration of the Advanced Camera for Surveys, 2003
  - The photometry of outer-halo globular cluster NGC 2419, 2003

Hien Tran, Ph.D., Astronomer
(100% FTE)

- Analysis of data from SMOV program to monitor ACS UV contamination.
- Analysis of ACS ERO data of Tadpole and Mice galaxies.
- Analysis of data from Keck observations of Tadpole galaxy.
- Prepared paper on Tadpole results for publication in the Astrophysical Journal.
- Continuation of ACS and Keck ERO data analysis.

Zlatan Tsvetanov, Ph.D., Astronomer
(50% FTE, 12-1-01; 100% 1-1-02 to 11-30-02)

- Coordinate submission and follow-up of basically all GTO programs including
  - Maintain the ACS/JHU Web pages for Phase I and Phase II.
  - GTO/ACS Phase I and Phase II submission to STScI
  - Assist many ACS program leads in preparing Phase II proposals
  - Check/evaluate all GTO/ACS phase II proposals
- Calibration data analysis
  - Active participation in the SMOV and some of the cycle 11 calibration activities.
  - Continue to provide filter analyses when needed
  - PI of one SMOV program - ramp filters on-orbit test.
  - Active role in ACS grism SMOV program.
- Grism sofware preparation:
  - Lead (ACS IDT side) the development of the s/w package.
  - Lead and participate in the bi-annual reviews.
  - Working of an IDL based Grism Analyses tool that when fully completed, should allow several functions:
    - direct image and grism spectra examination
    - object selection for further examination
    - emission line detection and measurement
    - template fitting and (over) plotting
    - redshift determination
    - spectral properties analysis

Wei Zheng, Ph.D., Astronomer
(50% FTE, 9-1-02-present)

- Test archive server and science database for bugs.
- carried out a search of the $z>6$ galaxies in the ACS fields.
- Submitted an NOAO proposal has been submitted for follow-up near-infrared observations to search for $z>7$ galaxies.

SYSTEMS/TECHNICAL SUPPORT

Terence S. Allen, Software Systems Specialist/Programmer
(100% FTE)

- Member of the Advanced Camera for Surveys (ACS) Science Data Archive (SDA) team.
- Maintained and updated XML-based ingest queue management application to handle messaging and data transfer between the data reduction pipeline and SDA.
- Developed and deployed the SDA user interface (UI), a www-based application used by the science team to access object catalogs, download calibrated and reduced image files, and perform data analysis tasks.
- Participated in ongoing development of new SDA user interface (UI) features and enhancements as requested.
- Maintained and released fixes to SDA UI as required.
- Performed all database administration, maintenance, and backup tasks for the SDA database server.
- Maintained and modified SDA data model as necessary.

Kenneth Anderson, Sr. Programmer/Analyst
(100% FTE)

- Official production version of Apsis, v1.0, released May 3, 2002
- 11 releases of Apsis to production since v1.0, addressing 39 separate Bugzilla issues
- 10,000+ lines of code in current production version of Apsis (v1.7) in 10 package modules and 7 utility modules
- CVS expertise for revision management of pipeline software and supporting files (DTDs, etc.)

Alex Framarini, Systems Manager
(100% FTE)
- Assisted with installation of hardware and software
- Provides user support
- Maintains printers
- Coordinates computing supplies ordering and set ups.

Wm. Jon McCann, Senior Systems Manager
(100% FTE)

In addition to items listed in Software and Hardware Development above …

- Performed testing of CALACS and provided several bug fixes during the critical ERO release period.
- Created three color images for the ACS team poster and Early Release Observations.
- Implemented a system to monitor availability and usage of services on all UNIX workstations. This system automatically alerts the system administration staff when a service is disrupted.
- Implemented a system to automatically monitor all system log files for alert conditions.
- Centralized all UNIX system logs.
- Designed, configured, and used a Solaris custom Jumpstart server to automate Solaris Operating Environment installations.
- Designed, configured, and used a RedHat Linux custom Kickstart server to automate Linux Operating Environment installations.
- Transitioned from static NFS mounts to a dynamic automount configuration.
- Planned and implemented the GridEngine distributed processing system.
- Conducted a complete UNIX system security audit.
- Overhauled all computing policies and procedures, particularly those related to security.
- Continue to develop and maintain the ACS web site.
- Performed analysis of ACS simulator design and performance which resulted in more than a factor of two performance increase.
- Supervise one senior staff member and one part-time undergraduate student assistant.
- Continued work with the ACS filter development group including re-analysis and archiving of data and the production of final ramp filter data packages.

STUDENT SUPPORT

Dan Coe, Graduate Student
(100% FTE)

- Preparing weak lensing analysis of Abell 1689 based on ACS and Keck images
- Performing BPZ analysis of A1689 using UBVRIZJHK and ACS griz filters
- Compiled spectroscopic redshift catalog of over 200 A1689 objects
- Performed supernova search in ACS A1689 images
- Preparing poster entitled "Weak Lensing and BPZ Analyses of Abell 1689 from ACS and Keck Observations" for "Dark Matter and Dark Energy in the Universe" Winter School at IAC, Tenerife, Spain, 18-29 November 2002
- Planning to attend a Gravitational Lensing conference in January

Myungkook Jee, Graduate Student
(100% FTE since June 1, 2002)

- Completed photometric Transformation between WFC and HRC

- Completed Encircled Energy Analysis of WFC and HRC
- Working on photometric calibration of ACS for major filters
- Working on photometry of Globular Cluster NGC 2419
- Paper in prep: The photometric calibration of the Advanced Camera for Surveys, 2003
- Paper in prep: The photometry of outer-halo globular cluster NGC 2419, 2003
- Attended HST 2002 Calibration Workshop, STScI

Kerry Zekser, Graduate Student
(100% FTE since January 1, 2002)

- Arc modelling software study
- Development of an automated web-based cluster arc database (Its infrastructure is easily applicable to future clusters beyond Abell 1689.)
- Automated WFPC2 alignment processing software development (It aligns all WFPC2 images for a particular region, i.e. Abell 1689, to a reference ACS image of interest.)
- Abell 1689 Arc/Arclet Photometry from ACS and eventually WFPC2 (Full-field galaxy modelling and subtraction and highly specialized photometry determinations of the cluster arcs)
- Future joint publications relating to Abell 1689
    o Abell 1689 Arc/Arclet Catalog
    o Arc modelling involving a couple arcs and arclets to provide a quick lensing model of Abell 1689 Tom Broadhurst etc.
    o Detailed and iterative arc modelling of the cluster and the plethora of arcs and arclets observed in the ACS data
    o Combining the weak and strong lensing results into a unified model Separate publication or included in another

ADMINISTRATIVE SUPPORT

Sharon Busching, Technical Administrative Assistant
(85% FTE, 12-1-01 to 11-30-02)

- Coordinated February 02 ACS science team meeting
- Coordinated first annual ACS science retreat meeting
- Ordered and performed follow-up where necessary on equipment, supplies purchases, and maintenance contracts
- Implemented searches for postdoctoral staff
- Balanced monthly project budget statements
- Coordinated office space, supplies and payroll for new personnel
- Participated in ACS poster design committee

ACS RESULTS IN REFEREED PUBLICATIONS:

1. Tran, H.D., Sirianni, M., Ford, H.C., Illingworth, G.D., Clampin, M., Hartig, G., Becker, R.H., White, R.L., Bartko, F., Benitez, N., Blakeslee, J.P., Bouwens, R., Broadhurst, T.J., Brown, R., Burrows, C., Cheng, E., Cross, N., Feldman, P.D., Franx, M., Golimowski, D.A., Gronwall, C., Infante, L., Kimble, R.A., Krist, J.E., Lesser, M., Magee, D., Martel, A., McCann, W.J., Meurer, G.R., Miley, G., Postman, M., Rosati, P., Sparks, W.B., Tsvetanov, Z. 2002, "ACS Observations of Young Star Clusters in the Interacting Galaxy UGC 10214," 2003, ApJ, 585, to appear in March 10 issue.

CONFERENCE PROCEEDINGS:

1. Blakeslee, J.P, Anderson, K.R., Meurer, G.R., Benitez, N., and Magee, D. 2003, An Automatic Image Reduction Pipeline for the Advanced Camera for Surveys, in ASP Conf. Ser., Astronomical Data Analysis Software and Systems XII, ed. H. Payne, R. Jedrzejewski, R. Hook, in press.

2. Clampin, M., Ford, H.C., Golimowski, G., Gronwall, Hartig, G., Illingworth, G., Kimble, R., Krist, J.E., Martel, A., McCann, W.J., Meurer, G., Sirianni, M., Sparks, W., Tran, H. 2002, ACS Astronomical Performance, in Future EUV and UV Visible Space Astrophysics Missions and Instrumentation, eds. J. C. Blades & O.H. Siegmund, Proc. SPIE, Vol. 4854, in press [4854-25].

3. Ford, H., Clampin, M., Hartig, G., Illingworth, G., Sirianni, M., Martel, A., Meurer, G., McCann, Wm. J., Sullivan, P., Bartko, F., Benitez, N., Blakeslee, J., Bouwens, R., Broadhurst, T., Brown, R., Burrows, Campbell, D., Cheng, E., Feldman, P., Franx, M., Golimowski, D., Gronwall, C., Kimble, R., Krist, J., Lesser, M., Magee, D., Miley, G., Postman, M., Rafal, M., Rosati, P., Sparks, W., Tran, H., Tsvetanov, Z., Volmer, P., White, R., Woodruff, R., Overview of the Advanced Camera for Surveys On-orbit Performance, in Future EUV and UV Visible Space Astrophysics Missions and Instrumentation, eds. J. C. Blades & O.H. Siegmund, Proc. SPIE, Vol. 4854, in press [4854-23].

4. Hartig, G., Krist, J., Martel, A., Ford, H., Illingworth, G. 2002, On-orbit Alignment and Imaging Performance of the Advanced Camera for Surveys, in Future EUV and UV Visible Space Astrophysics Missions and Instrumentation, eds. J. C. Blades & O.H. Siegmund, Proc. SPIE, Vol. 4854, in press [4854-33].

5. Illingworth, G., Ford, H., Clampin, M., Hartig, G., Bartko, F., Benitez, N., Blakeslee, J., Bouwens, R., Broadhurst, T., Brown, R., Burrows, C., Cheng, E., Feldman, P., Franx, M., Golimowski, D., Gronwall, C., Kimble, R., Krist, J, Lesser, M., Magee, D., Martel, A, Meurer, G., Miley, G., Postman, M., Rosati, P., Sirianni, M., Sparks, W., Tran, H., Tsvetanov, Z., White, R. 2002, HST ACS Early Science Results, in Future EUV and UV Visible Space Astrophysics Missions and Instrumentation, eds. J. C. Blades & O.H. Siegmund, Proc. SPIE, Vol. 4854, in press [4854-24].

6. Krist, J., Golimowski, D., Hartig, G., Clampin, M., Ford, H. 2002, The Advanced Camera for Surveys Coronagraph on the Hubble Space Telescope, in Future EUV and UV Visible Space Astrophysics Missions and Instrumentation, eds. J. C. Blades & O.H. Siegmund, Proc. SPIE, Vol. 4854, in press, [4860-03].

7. Martel, A.R. and Hartig, G.F., 2002, Pre-launch Calibration of the Advanced Camera for Surveys, SPIE Opto-Canada Regional Mtg. Vol. TD01 (Ottawa), May 2002, 57.

8. Meurer, G., Lindler, D., Benitez, N., Blakeslee, J., Bouwens, R., Clampin, M., Cox, R.C. 2002, Calibration of Geometrical Distortion in the ACS Detectors, in Future EUV and UV Visible Space Astrophysics Missions and Instrumentation, eds. J. C. Blades & O.H. Siegmund, Proc. SPIE, Vol. 4854, in press [4854-30].

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INTERNAL REPORTS:

1. Jones, M.R., Schrein, R., Sirianni, M. , Vu, P.,. "BAE Systems Charged Coupled Device Radiation Test results" 2002 GSFC-NASA internal Report

2. Martel, A.R, Hartig G, Sirianni, M., "On-orbit HRC and WFC Internal Tungsten lamp Count Rates" 2002 JHU ACS internal Report

SUBCONTRACTS

Bartko Science and Technology
P.I. of subcontract: Frank Bartko

(Report on attached pages.)

University of California, Santa Cruz
P.I. of subcontract: Garth Illingworth

Personnel:

A postdoc, Rychard Bouwens, was fully supported by the ACS program during FY02, as well as partial support of a student, Kim-Vy Tran, and research assistant/programmer, Dan Magee.

Major activities:

This year divided naturally into two very different periods -- pre- and post-launch. Pre-launch the group effort focused on i) preparing for the ACS cluster science program, under the guidance of the deputy-PI, and ii) supporting the whole ACS science program through contributions to the data pipeline development. The deputy-PI continued his extensive support for the program, working closely with the PI to ensure that the instrument performance requirements were met and that the science program will meet its objectives. With the successful launch of the ACS during 2002 the effort of the Santa Cruz group focused more on data calibration issues, and exploring and recovering science from the first images, particularly in support of the ERO program, and dissemination of the first science results from the ACS.

The team members have contributed as follows:

Rychard Bouwens continued the development of his simulator for the ACS observations, with particular emphasis on including many complicated (from a simulation perspective) but important observational features like cosmic rays, non-uniform flats, geometric distortion, and charge diffusion. This simulator is being used both to assist in testing the pipeline for processing the ACS observations, as well as for optimizing the GTO science program. Particular questions that he has addressed include the value of ACS GRISM both for determining the redshift of typical intermediate redshift cluster and field galaxies or for identifying high redshift (z~6) emission-line objects in random pointings, as well as the likely flux and sizes of very high redshift galaxies. In this area he has been helping to optimize our plan for discovering a population of z~6 objects using the well-known dropout technique using lower redshift samples as a baseline. His simulations were used to generate an image for a very widely distributed ACS poster produced at GSFC.

Scientifically Rychard Bouwens has been investigating the manner in which galaxies evolve in size, number, or luminosity at high redshift by projecting lower redshift samples from the Hubble Deep Fields to higher redshift for the purposes of comparison with these same fields. Thus far, for flat or lambda-dominated geometries, he has found a curious decrease in mean intrinsic size

of UV bright galaxies from z~3 to z~5. This work is important both for what reveals about the nature of high-z star formation and as preparation for much more comprehensive field work with the ACS. The paper on this was submitted to the Astrophysical Journal, and is being revised following the referee report. Rychard has now begun to use the techniques developed in the WFPC2 HDF-N paper for the ACS field galaxy data. These will prove to be very powerful for constraining the highest redshift galaxies (those around z~6).

Rychard worked hard to provide a first cut at potential z~6 dropout candidates for science talks this summer, from the early ACS data and so helped us give visibility to the ACS's capabilities. His experience and insight have proven to be very valuable for the team.

Dan Magee has continued work on the development of the data analysis pipeline (APSIS) that will be used to automatically process the GTO program observations. His primary focus has been in the development of a software package that automatically searches the Science Data Archive (SDA) for new and updated data, groups the data into logical data sets, and initiates an unattended APSIS pipeline run of the data sets. He also continues work with GTO archive team with development of software for SDA.

Dan has also provided support in the planning and implementation of ACS and ground base observations of GTO targets. He continues to provide system administration and support on Linux platforms for the UCSC component of the GTO team. His duties include maintaining and upgrading systems and equipment, troubleshoot and repair of malfunctioning equipment, and install, manage and support astronomy and scientific software packages. Dan also provides assistance in evaluation and implementation of new technologies which may benefit the GTO team. The ground-based observations with Keck are a key part of the complementary data needed to analyze the ACS data. Dan has supported the Keck runs with generation of the astrometric solutions for the fields and mask production, as well as being an experienced observer.

Kim-Vy Tran extensively tested and worked with the GIM2D galaxy fitting program. The goal of this work was to understand the program's strengths and limitations. This is a continuation of work begun the previous year. Multiple profiles have been fitted, e.g. de Vaucouleurs, exponential, Sersic, and combinations of these three, to hundreds of galaxy images and thousands of mock galaxies to derive the systematic and random errors associated with measuring structural parameters using a PSF-convolved, two dimensional model. The observed data samples ranged from ground-based, nearby galaxies to dithered HST WFPC images of high redshift galaxies. She also incorporated sophisticated simulations of galaxies as they would be observed by ACS in the tests (from Bouwens). She communicated often with Luc Simard (the original developer of the program) concerning ways to improve the program's speed, efficiency, and overall robustness. The result of these efforts is a program that measures physical properties of galaxies in a quantitative and quite robust manner. She prepared a paper that will describes much of this work, and has submitted that to the Astrophysical Journal. Her work came to fruition with the awarding of her PhD after a very intensive effort on the galaxy properties in high redshift clusters.

The deputy-PI has been overseeing the efforts of the group, working closely with the individual members on planning activities. Extensive time and effort has been committed also to developing the team's overall science program in conjunction with the PI, as well as working with the PI to ensure that the science data processing techniques, the software resources, the science database, and the team personnel are being utilized effectively for our program. These responsibilities have required many trips to be taken to Baltimore to work with the PI at JHU.

The deputy-PI has also been very active this year in working with the PI on planning for the ERO program. The subsequent processing and development of the release involved considerable effort. The mission itself also required a considerable investment of time. In particular, the launch support involved an extensive commitment of effort, with the PI and deputy-PI sharing the effort involved on supporting the ACS at GSFC and JSC (respectively). Getting the first results out for various meetings and presentations also took priority once the initial data was received. Talks on the science program were given at the June AAS meeting and at the SPIE meeting in August.

Two Keck observing runs were also supported where the data and the science results will be used for our ACS science program -- the spectroscopic data will be used to constrain the evolution of galaxies in the cluster environment at redshifts $z>0.5$. Such data will provide the baseline on which we will build our higher redshift ACS cluster results.

These activities are structured so as to allow us to have i) a scientific program that keeps current with the latest developments in our field so that we can structure our observations to ensure that it is up-to-date, and is focused on contemporary issues and questions, and ii) supports the team's efforts in getting scientific results out from the new ACS data as quickly as possible.

Significant equipment purchases and updates:

Three Dell desktops were acquired during the year, just before launch. These Linux systems provided a substantial increment in data handling capability as we began to work with the HST calibration, ERO and GTO datasets.

The laptops (also Linux/windows) continued to be very valuable tools, enabling the group to deliver PowerPoint presentations at talks and the ability to provide a mobile platform for scientific data analysis which approaches desktop Linux system. The group's desktop and laptop systems were upgraded at various times during the year to take advantage of significant improvements in personal computer hardware (memory, disk drives etc...) as the processing etc requirements began to increase with the new data.

Space Telescope Science Institute
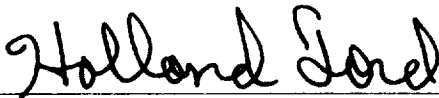**P.I. of subcontract: Mark Clampin**

- Pre-launch activities
    - o Led the ACS pre-launch installation and test procedures
- SMOV Activities
    - o ACS team at STScI played major leadership roles:
        - EVA Support

- AT/FT science data evaluation
- In-orbit alignment of ACS
- ACS CCD switch-on and thermal evaluation
- general support of ACS SMOV programs
- support for SMOV issue troubleshooting:
  - resolution of throughput measurements with ground test data
  - coronagraph implementation
- support for ACS ERO program and analysis of data
- presentation of ERO data at Space Congress & NASA Origins Board
- ACS Science Activities
  - Analysis and interpretation of ACS ERO observations
  - Analysis of ACS ERO observations
  - Analysis of initial ACS science observations
  - presentation of ACS results at AAS meetings

GSFC
P.I.: Randy Kimble

- performed data analysis of SMOV testing of SBC detector (in particular dark rate) and co-authored AAS poster on this topic
- participated in science team meetings and reviews (e.g. pre-ship review, data archive, and pipeline reviews)

Signed: _____
          Holland Ford, P.I.

cc: Jim Jeletic, GSFC, c/o B. Matters, Building 7, Room 264B
       S. Dezio, GSFC, Code 210, Building 28, Room N130
       NASA Ctr. for Aerospace Information
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ACS TECHNICAL REPORT #4
ACS Grant
October 1, 2001 to September 30, 2002

Frank Bartko

During the above period, the following effort was completed on the ACS Science Grant:

Accomplishments:

1. Participated in the pre-launch Science team meeting at KSC--- Plans for data analysis for the ERO program and SMOV activities were implemented.
2. Participated in the discussions at the ACS science team meeting at Jackson Hole. We reviewed early   ERO science and initial GTO cluster survey results.
3. Participated in the ACS poster sessions at the SPIE conference in Hawaii.
4. Started work on analysis of cluster data with Holland Ford. We analyzed the data in the Science Data Archive on the cluster 1252-2927. We generated C-M diagrams, Color-Color plots, identified possible mergers and identified I Band dropouts.

Purchases/Expenditures Charged to Grant to Date:

1. Travel to KSC for the ACS launch
2. Travel to the AAS meeting in Albuquerque
3. Travel to the Jackson Hole Science Team meeting
4. Travel to the Hawaii SPIE meeting

Advanced Camera
f o r   S u r v e y s

JOHNS HOPKINS
U N I V E R S I T Y

GTO Science Programs - Cycle 11

Last Updated: | also see: ERO Programs

GTO Science Programs Cycle 11

		ACS ID	Prop. ID	Orbits Req	Exec	Proposer
Evolution of Galaxies and Clusters of Galaxies						
Low Redshift Gravitational Lensing Survey		AC02	9289	23	23	Broadhurst/Benitez
Evolution of Clusters at Intermediate Redshifts		AC03	9290	80	60	Postman
Formation of High Redshift Radio Galaxies		AC04	9291	26	13	Miley
The Nature of Galaxies at z > 4		AC05	9292	16	16	Illingworth
Photometry and Grism Spectroscopy in HDF North/South		AC16	9301	14	14	Franx/Illingworth
			sub total	**159**	**126**	
Active Galactic Nuclei						
Massive Black Holes in Early Type Galaxies		AC06	9293	32	0	Ford/Tsvetanov
Observations of QSO Host Galaxies		AC07	9294	15	0	Hartig/Martel
			sub total	**47**	**0**	
Stars and Stellar Systems						
Coronographic Search for Planets around Nearby Stars		AC08	N/A	0	0	Ford
A Search for Planets around the Brown Dwarf Gliese 229B		AC09	9303	5	0	Golimowski
Coronographic Searches for Disks around Nearby Stars		AC10	9295	16	3	Clampin
Stars in Extended HI Disk Galaxies		AC01	9288	4	0	Meurer
Star Formation in Starburst Regions		AC15	9300	4	4	Clampin/Sirianni
Polarimetry of Light Echos		AC14	9299	12	9	Sparks
			sub total	**41**	**16**	
Solar System Objects						

ACS Programs Cycle 11

	ACS ID	Prop. ID	Orbits Req/Exec		Proposers
Jovian Satellites	AC11	9296	5	0	Feldman
Comets: Gas in the Inner Coma	AC12	9297	4	0	Feldman
Comet Hale-Bopp at Large Heliocentric Distance	AC17	9302	2	2	Feldman
Kuiper Belt Objects Search	AC13	9298	6	0	Feldman/Brown
		sub total	17	2	
Team Reserve				2	Ford
Total cycle 11 ACS GTO orbits: requested/executed			264	146	

Combined GTO Target List (pdf)